UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2010/2011

April/May 2011

EBP 412/3 - Specialty Engineering Polymers
[Polimer Kejuruteraan Khusus]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains SEVEN printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions.
[Kertas soalan ini mengandungi TUJUH soalan.]

Instruction: Answer **FIVE** questions. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

…2/-

1. [a] Why do some polymers are termed as 'liquid crystal polymers'?

Mengapa sesetengah polimer dikenali sebagai 'polimer cecair hablur'?

(20 marks/*markah*)

[b] Describe the three structural components of an LCP and how each of them contribute to the property of the liquid crystal.

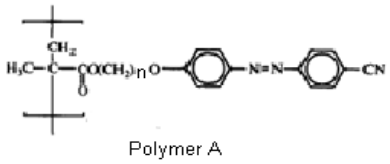
Perihalkan tiga komponen dalam struktur polimer cecair hablur serta bagaimana setiap satunya menyumbang dalam memberikan sifat cecair hablur.

(30 marks/*markah*)

[c] Figure 1 shows the DSC scans at various *n* values (left column) for a liquid crystalline polymer A. Based on the DSC scans, discuss the effect of *n* values on the glass transition of this polymer. Does the odd-even values of *n* affect the phase transition of this polymer? If yes, please explain.

Rajah 1 menunjukkan imbasan DSC pada beberapa nilai n (kolum kiri) bagi polimer cecair hablur A. Berdasarkan imbasan DSC ini, bincangkan kesan nilai n terhadap sifat peralihan kaca bagi polimer ini. Adakah nilai ganjil-genap pada n mempengaruhi peralihan fasa polimer ini? Jika ya, jelaskan.

(50 marks/*markah*)



Polymer A

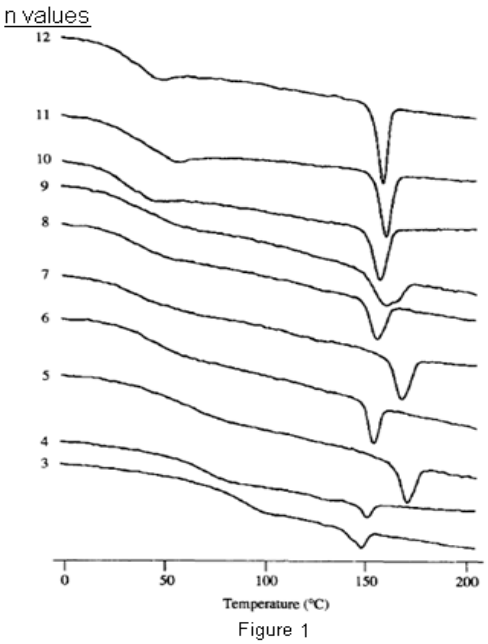


Figure 1

Figure 1

Rajah 1

2. [a] Given that polymers are devoid of any free electrons, describe how electrical conductivity could be achieved in these materials.

Berdasarkan ketiadaan elektron bebas dalam polimer, bincangkan bagaimana pengaliran arus elektrik boleh berlaku dalam bahan ini.

(40 marks/*markah*)

[b] A polyphenylene of volume 18.3 cm^{-3} was doped with 4.0 µg antimony having a charge mobility of 0.8 cm^2/Vs. Assuming that each antimony atom could donate an electron, calculate the conductivity of the polyphenylene. Given charge carrier 1.6 x 10^{-19} Coulomb, 1 mole of antimony weigh 121.76 g consisting of 6.02 x 10^{23} atoms.

Suatu polifenilena berisipadu 18.3 cm^3 telah di 'dop' dengan 4.0 µg antimoni dengan pergerakan cas bernilai 0.8 cm^2/Vs. Anggapkan setiap atom antimoni ini boleh menderma satu elektron, hitung nilai kekonduksian bahan polimer ini. Diberi nilai pembawa cas 1.6 x 10^{-19} Coloumb, 1 mol antimoni beratnya 121.76 g mengandungi 6.02 x 10^{23} atom.

(60 marks/*markah*)

3. [a] Briefly describe the following terms as applied during photolithographic process:

(i) Mask

(ii) Positive photoresist

(iii) Etching

Perihalkan secara ringkas istilah-istilah berikut seperti yang digunakan semasa proses fotolitografi.

(i) Topeng

(ii) Fotoresis positif

(iii) 'Etching'

(45 marks/*markah*)

[b] A photoresist as in Figure 2 was fabricated. Answer the following questions:

(i) At which suitable UV wavelength for this photoresist will be able to function.

(ii) Describe what happens when triphenylsulfonium triflate cation is added into this photoresist during the lithographic process.

(iii) Suggest effects of substituting one of the hydrogen in the adamantyl ring with fluorine.

Suatu fotoresis telah dihasilkan seperti dalam Rajah 2. Jawab soalan-soalan berikut:

(i) Pada jarak gelombang UV berapa paling sesuai bagi penggunaan fotoresis ini.

(ii) Jelaskan apa yang berlaku apabila kation trifenilsulfonium triflat dicampur ke dalam fotoresis ini semasa proses fotolitografi.

(iii) Cadangkan kesan apabila salah satu hidrogen dalam gelang adamantil ditukarganti dengan fluorin

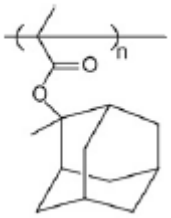


Figure 2

Rajah 2

(55 marks/*markah*)

4. [a] Discuss the importance of the following properties as required for an electronic packaging materials:

(i) High thermal dimensional stability

(ii) Low water absorption

(iii) Low dielectric constant

Bincangkan kepentingan yang berikut bagi keperluan bahan pembungkusan elektronik:

(i) Kestabilan dimensi termal yang tinggi

(ii) Penyerapan air yang rendah

(iii) Pemalar dielektrik yang rendah

(45 marks/*markah*)

[b] Polyimide display a relatively low dielectric constant compared to other polymeric materials. Briefly discuss the followings;

(i) Why is the dielectric constant of polyimide decrease as the frequency of applied electric field is increased?

(ii) Suggest two methods to decrease the dielectric constant of a polyimide.

Poliimida mempamerkan pemalar dielektrik yang agak rendah berbanding bahan polimer yang lain. Jelaskan dengan ringkas perkara yang berikut:

(i) Kenapa pemalar dielektrik poliimida menurun apabila frekuensi medan elektrik yang diguna meningkat?

(ii) Cadangkan dua kaedah bagi meningkatkan pemalar dielektrik poliimida.

(55 marks/*markah*)

5. [a] Describe briefly what is the difference between nanoparticle and colloidal particle. Where is the importance of nanomaterials in polymeric materials? Suggest what kind of product can be obtained from the mixture of nanoparticles and a polymer such as Kevlar.

Jelaskan secara ringkas apakah perbezaan antara nanozarah dan zarah colloid. Di manakah kepentingan zarah nano dalam bahan polimer? Bolehkah anda cadangkan produk yang dapat dihasilkan daripada campuran zarah nano dan polimer seperti Kevlar.

(50 marks/*markah*)

[b] How does the concept of sensitivity and resolution of photoresist related to miniaturization of integrated circuit (IC) fabrication.

Bagaimana konsep sensitiviti dan resolusi bagi fotoresis berkait dengan proses pengecilan suatu litar bersepadu.

(50 marks/*markah*)

6. [a] What is biopolymeric material? Explain briefly how these materials are becoming more importance in advanced composite materials. Name FIVE biopolymeric materials which are commonly used as composite materials.

Apakah bahan biopolimer? Jelaskan secara ringkas kenapa bahan ini menjadi tumpuan dalam penyediaan bahan komposit termaju. Berikan LIMA bahan biopolimer yang sering digunakan sebagai bahan komposit.

(50 marks/*markah*)

[b] Plastics are classified as thermoplastic and thermosetting. If you are asked to produce a composite material for a racing car or airplane, which of these materials you prefer to use as a matrix of you composite? Explain briefly to support your choice.

Termoplastik dan termosetting merupakan dua bahan polimer yang diletakan dalam kelas plastik. Jika anda diminta untuk menghasilkan bahan komposit bagi kereta lumba atau kapal terbang, antara kedua bahan polimer itu manakah yang akan anda pilih sebagai bahan matriks? Terangkan secara ringkas ZXbagi menyokong pilihan anda.

(50 marks/*markah*)

7. [a] What is chitosan and how could you produce it in small scale industry?

Apakah itu kitosan dan bagaimana menghasilkannya secara kecil-kecilan?

(30 marks/*markah*)

[b] What are the major applications of chitosan?

Apakah penggunaan utama kitosan?

(30 marks/*markah*)

[c] Could you suggest other possible new product that can be obtained from chitosan and give scientific reasons for your choice.

Bolehkah anda cadangkan apakah produk baru yang boleh dihasilkan daripada kitosan dan berikan alasan sains yang sesuai.

(40 marks/*markah*)

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